



AFS Operator's Manual

AFS-1

AFS-2

AFS-3

AFS-1HS

AFS-2HS

AFS-4HS

Every AFS machine is fully tested, lines balanced and gas sensors calibrated before it leaves the factory. Please follow instructions in the following pages to ensure setpoints are correct for your facility.

Note: This manual contains photographs and screen shots of an AFS-4. This manual and all operator functions are applicable to: AFS-1, AFS-2, AFS-4, AFS-1HS, AFS-2HS, and AFS-4HS. All efforts have been made to cover all settings and any changes to recommended settings should be fully understood by the operating facility.

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General Information

The AFS gas filling systems are designed to replace the resident air in an insulating glass unit (IGU) with argon gas. The argon gas acts as an insulating agent along with resisting fogging. The process used to complete this function utilizes flow in/out balancing which allows the process to be both fast and safe by reducing the breakage due to over pressurization of the IGU or over-vacuum created by other non-balanced flow systems. The AFS system does not use a vacuum pump to create the flow out of the IGU, so the loud noise, maintenance and mess of a vacuum pump is not an issue.

Components

All AFS systems consist of the following major components:

- Enclosure (NEMA-12), may be wall mounted or fitted for a cart
- Programmable Logic Controller (PLC with 5.7 color screen)
- Programmable logic controller input/output modules
- Start and stop pushbuttons (Illuminated to indicate present status of each line)
- Emergency stop pushbutton (E-STOP)
- Alarm horn
- Male argon feed port
- Male plant air port
- Three pronged male electrical outlet
- Argon feed ports (1/4" or 3/8")
- 3/8 inch vacuum return ports (3/8" or 1/2")
- Fill probes with 12 foot tubing – color coded by line
- 24 VDC power supply
- Argon pressure transducer
- Plant air pressure transducer
- Gas level sensor/transmitters (One for each line, located in the vacuum return line)
- Argon flow meters (each line independent)
- Vacuum line flow meters (each line independent)
- Vacuum generators (each line independent)
- Argon pressure regulator
- Plant air pressure regulator
- Misc. terminals, wire connectors and fittings

Options: *(Options manual is a separate document)*

- Probe Remote Start Push Button
- Data Collection program with SD card
- Ethernet connection
- Bar Code Scanner and program

SET UP

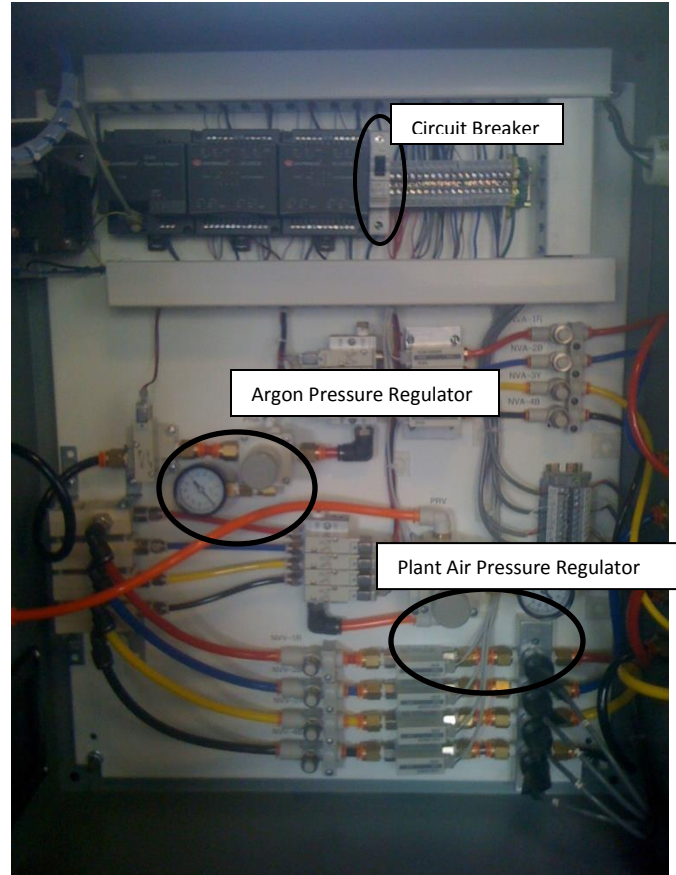
The AFS panel must be securely mounted, power must be connected to the male electrical socket via any standard 3-pronged extension cord, plant air-line must be connected to the male 'AIR' port, argon line must be connected to the male 'ARGON' port and then the internal power "Circuit Breaker" must be turned to the on position.

Plant Air pressure ~ 100 PSI (recommend ½" feed line from main header)

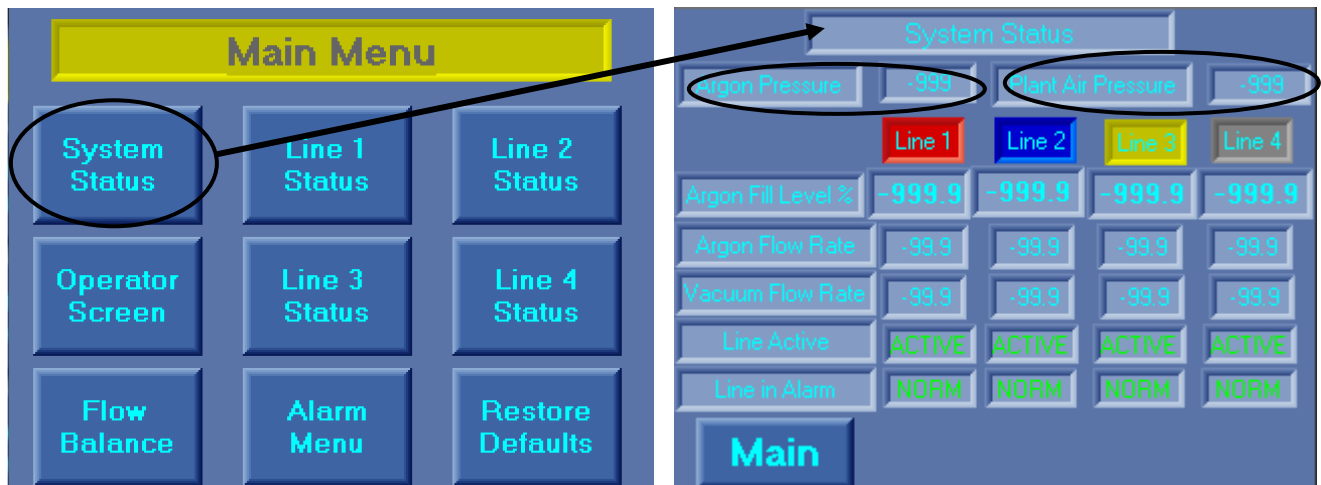
Argon Pressure at tank regulator ~ min. 80 PSI

Note: To ensure enough plant air, we recommend at least ½ inch line from main air manifold/header.

Ensure the argon tank manifold and hose is capable of 200 lpm. (400 lpm for AFS-4HS)



From the 'Main Menu' screen – press the 'System Status' button.



Start any line by pressing its green start button on the front panel. Adjust the internal "Argon Pressure Regulator" (PRA) until the PLC reading for 'Argon Pressure' reads **40 PSI**. Repeat the same procedure for the incoming 'Plant Air Pressure', adjust the "Plant Air Pressure Regulator" (PRV) until the on-screen pressure reads **80 PSI**.

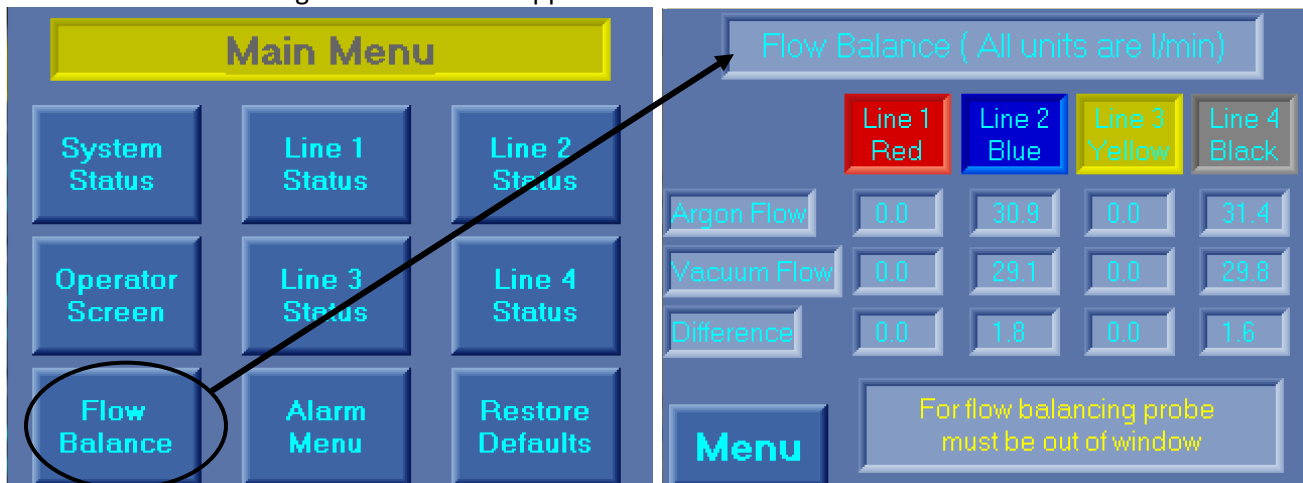
Press the 'Main' button to return to the 'Main Menu'.

FLOW BALANCE SETPOINTS (required for each line)

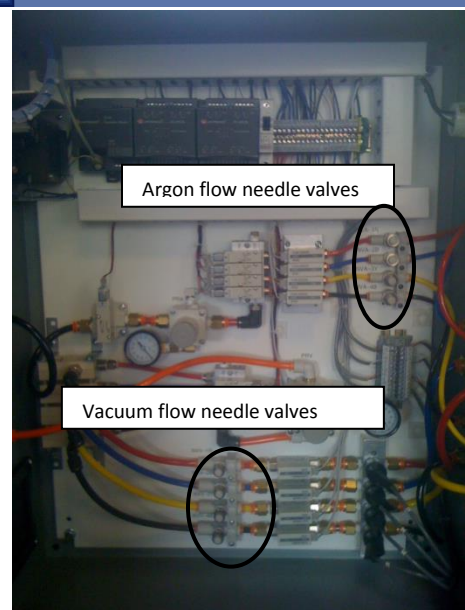
While the system will be factory calibrated before shipment, it is advised and good practice to balance the feed and vacuum flows for each line. Balancing of each line is also advised on a periodic basis or when adjustments are made to argon feed level pressure or plant air pressure. Periodic balancing is required to allow the system to contend with variances in ongoing conditions including temperature, humidity, wear and tear of equipment, etc. Balancing of a line is achieved by the following procedures:

Note: When flow balancing, the tubing lines and probes must be connected – with argon and plant air turned on. Probe must be out of any IGU or calibration chamber.

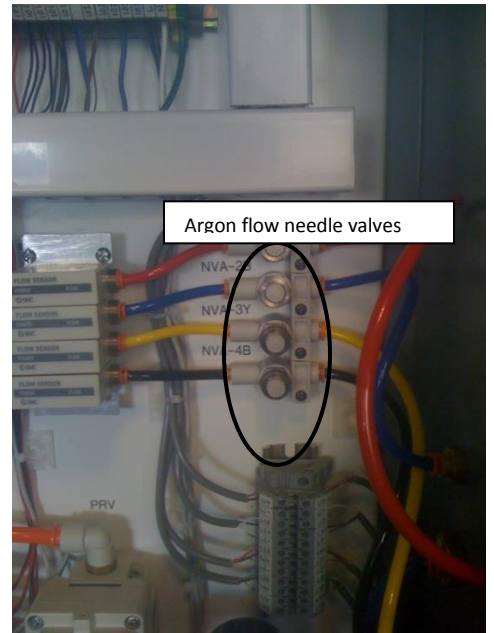
1. Connect the argon and vacuum tubing to the ports to be balanced as labeled on the right side of the enclosure. (Line 1 – Red, Line 2 – Blue, Line 3 - Yellow, Line 4 – Black).
2. Make sure that the probe is securely connected to the end of the tubing.
3. From the 'Main Menu' screen, press the 'Flow Balance' button on the PLC touch screen. The 'Flow Balancing' screen will then appear.



4. This screen displays the 'Argon Flow', 'Vacuum Flow' and the 'Difference' between these flows for each of the four lines. Proper flow balancing provides a slightly positive 'Argon Flow' over 'Vacuum Flow' reducing the chances of a pressure differential that cause the window to explode or implode.
5. With the probe left out of the IGU, press the green start push-button on the front of the panel for the line you are balancing. Observe the argon and vacuum flow rates via the flow balancing screen.



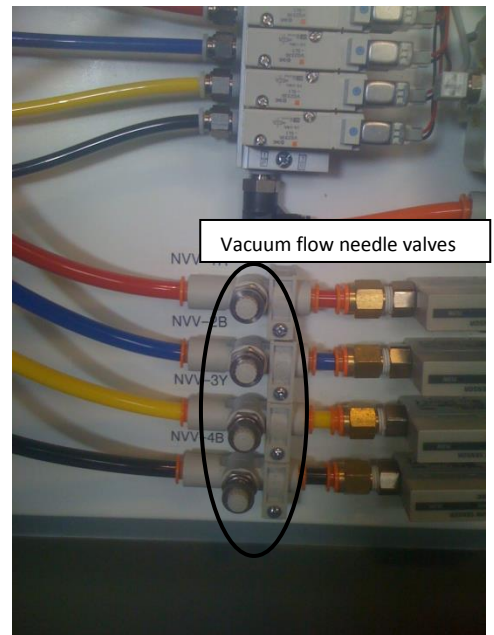
- Adjust the appropriate argon needle valve (NVA-1R, NVA-2B, NVA-3Y and NVA-4B) located inside the panel until the desired flow rate is achieved.



- Adjust the appropriate Vacuum needle valve (NVV-1R, NVV-2B, NVV-3Y, and NVV-4B) located inside the panel until the flow balance is a positive 1.6 to 1.8 slpm.

Note: These values are recommended for normal use. Ensure these settings are adequate for your IG sizes and flow differential alarm settings.

- Repeat steps 4 through 6 for each of the other lines.
- Press 'Menu' to return to the Main Menu.



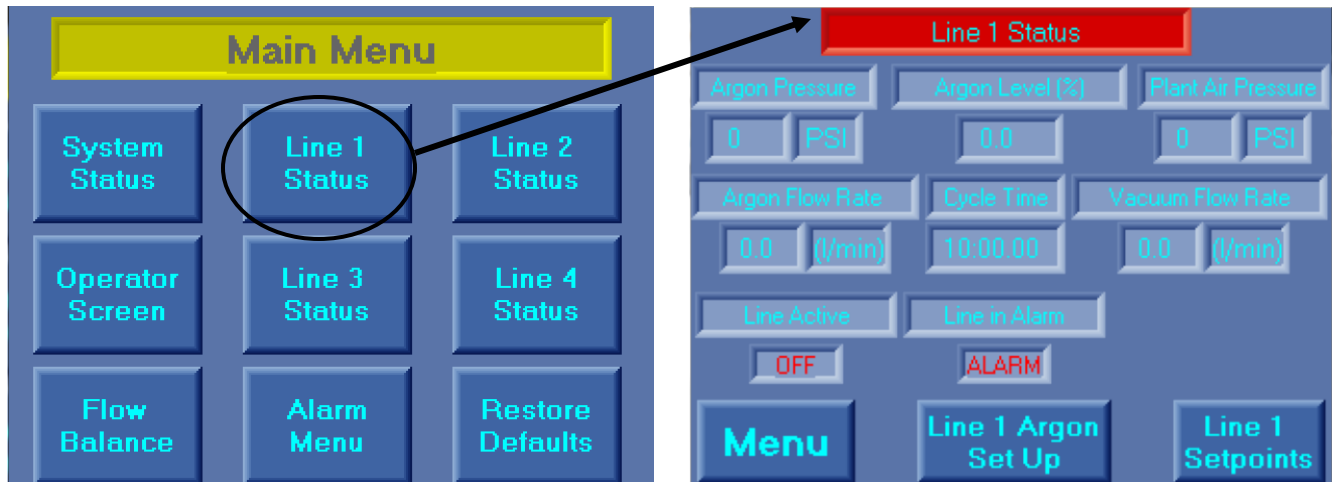
Note: For maximum flow – start with each vacuum needle valve at the fully open position, and adjust the argon needle valve to achieve a flow “Difference” as noted in step 7. (positive argon flow)
(The system is typically limited by the vacuum side – due to concentric probe design. Starting with the vacuum flow needle valves in the fully open position, will allow for maximize flow rate.)

Note: Each line may have different flow rates – this is normal and is determined by probe variances, tubing variances, etc. Each line is independent and operation will be determined by individual line setpoints.

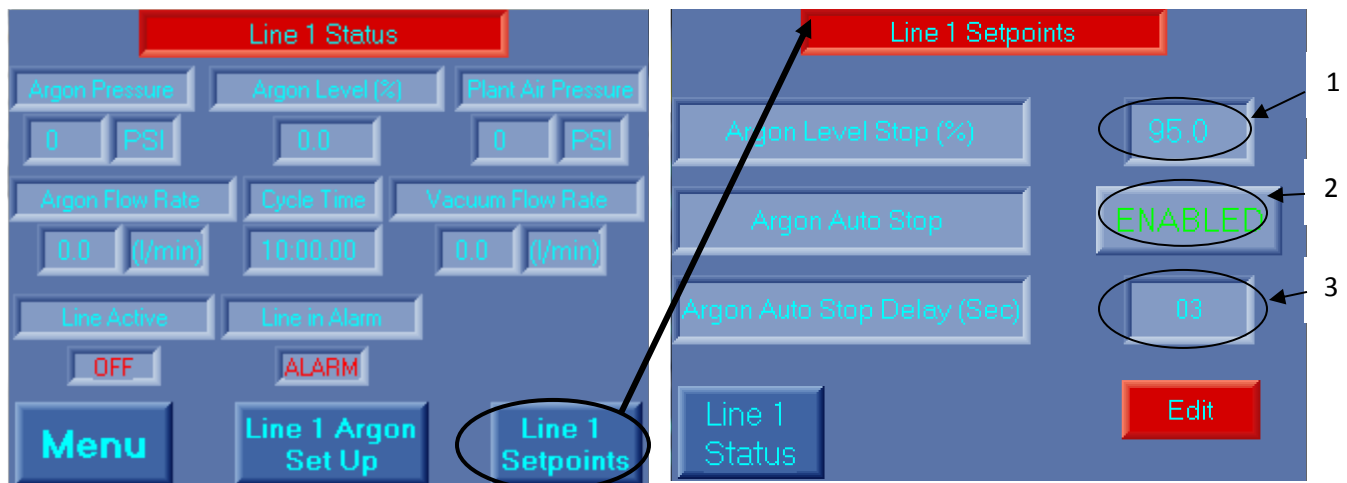
Note: Any negative flow differential will result in drawing air into the IG – continually diluting the argon. Ensure the flow “Difference” is positive.

GAS SENSOR AUTO STOP SETPOINTS

For each of the four lines there exists a setpoint screen allowing for a selectable 'Argon Level Stop %' and an over-fill timer that starts counting when the fill level reaches the desired setpoint.



To access this screen the operator must press the button labeled 'Line 1 (2, 3 or 4) Status' on the 'Main Menu'. 'Line 1 (2, 3 or 4) Setpoints' button in the lower right corner of this screen must then be pushed.



A screen will appear that will allow the user to Enable or Disable the auto stop of the filling cycle through that line, adjust the desired fill level (%) of argon, and also adjust the over-fill time in seconds.

Note: To make changes to these set points – First press “Edit” button – then enter security code (1234) - then the enter symbol. The “Line # Setpoints” screen will now allow changes to be made. *(Applies to systems built summer 2013 and later)*

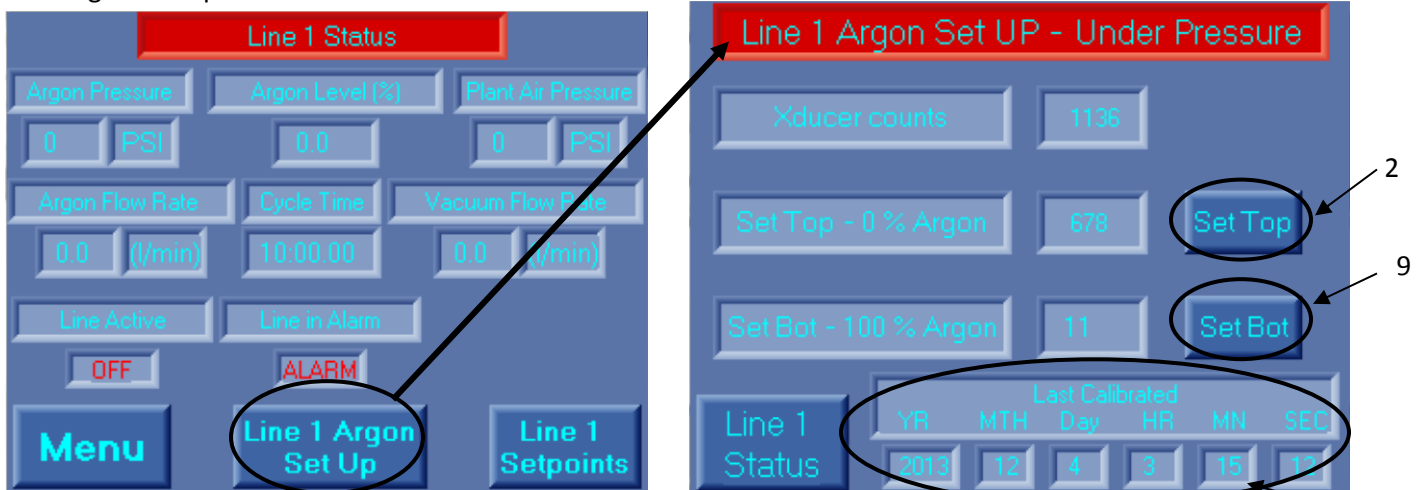
1. Set the 'Argon Level Stop (%)' by pressing the numerical digits relating to the setpoint. A numerical keypad will display. Enter the desired Argon fill level (in % fill) and hit the enter key.
2. To Disable the Argon Auto Stop – Touch the 'Enable' button. To enable, touch the Disable button. **(DISABLE THIS FEATURE ONLY FOR GAS SENSOR MAINTENANCE OR REPLACEMENT)**

3. Set the desired 'Argon Auto Stop Delay' by touching the numerical button – and enter the desired number of seconds to fill after 'Argon Level Stop' value is reached. This feature allows for a timed over-fill, increasing the level of the final fill. A 3 second delay is a typical value.

After these adjustments have been made, back out of this display to the 'Line 1(2, 3 or4) Status' screen (push 'Line 1 (2, 3, 4) Status' button) and then back to the 'Main Menu' screen (push 'Menu' button). The individual line setpoint screen only has to be used when initially setting up the system and then only periodically thereafter when maintenance chooses to alter any of the three parameters listed on that screen.

GAS SENSOR CALIBRATION

Initially and as a **monthly maintenance function**, the setpoints for the gas sensors should be reviewed. From the 'Main Menu', select the 'Line # Status' for the line to be adjusted, and then press the 'Line # Argon Set Up'.



Set 0% Argon Setpoint

1. With the probe in ambient air and not in an IGU, start the Argon filling cycle by pressing the green start button.
2. Wait until the 'Xducer counts' remains nearly constant. Compare the 'Xducer counts' value with the 'Set Top 0% Argon' value, after Xducer counts value has stabilized, press the 'Set Top' button to reset the 0% Argon setpoint of the sensor.
3. Stop the filling process by pressing the red stop button.

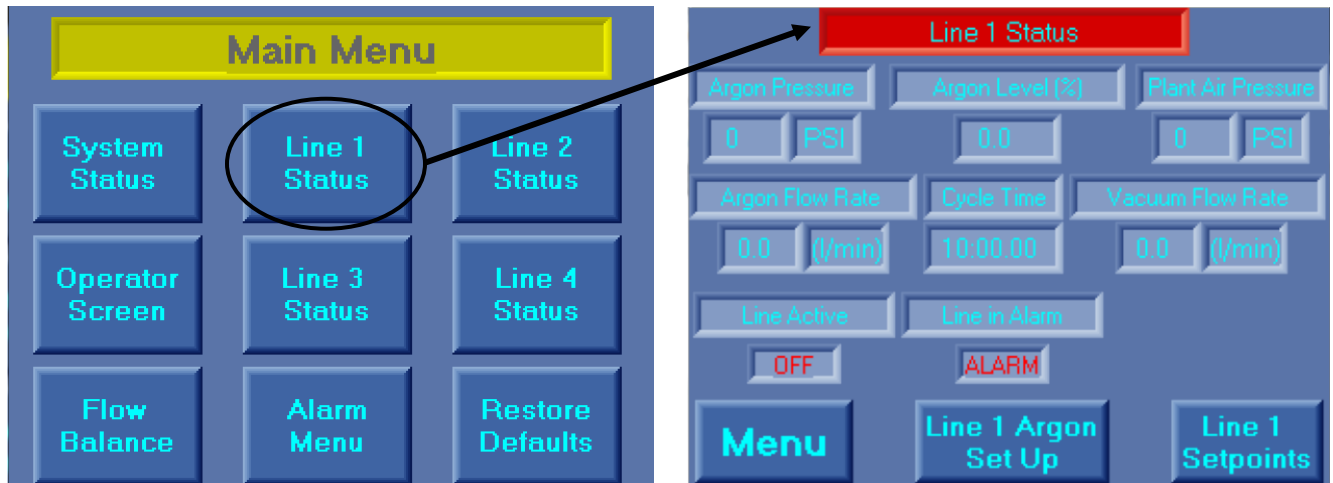
Set 100% Argon Setpoint

4. Go back one screen to the 'Line # Status' screen.
5. Press 'Line # Setpoints'
6. After the 'Argon Auto Stop' Press the 'Enable – Disable' button to disable the Argon Auto stop alarm.
7. Return to the 'Line # Argon Set Up' screen.
8. Place the probe in a small IGU or small sealed test chamber. Start the Argon filling cycle by pressing the green start button. The IGU or chamber should fill to nearly 100% argon concentration.
9. Wait until the 'Xducer counts' remains nearly constant. Compare the 'Xducer counts' value with the 'Set Bottom 100% Argon' value, after Xducer counts value has stabilized, press the 'Set Bot' button to reset the 100% Argon setpoint of the gas sensor.
10. Before finishing this procedure, re-enable the 'Argon Auto Stop' by repeating steps 4-6.
11. Each time that the operator calibrates either the top or bottom value the time is logged and shown in the lower right hand corner of the argon setup screen for that particular line. *(applies to systems built summer 2013 and later)*

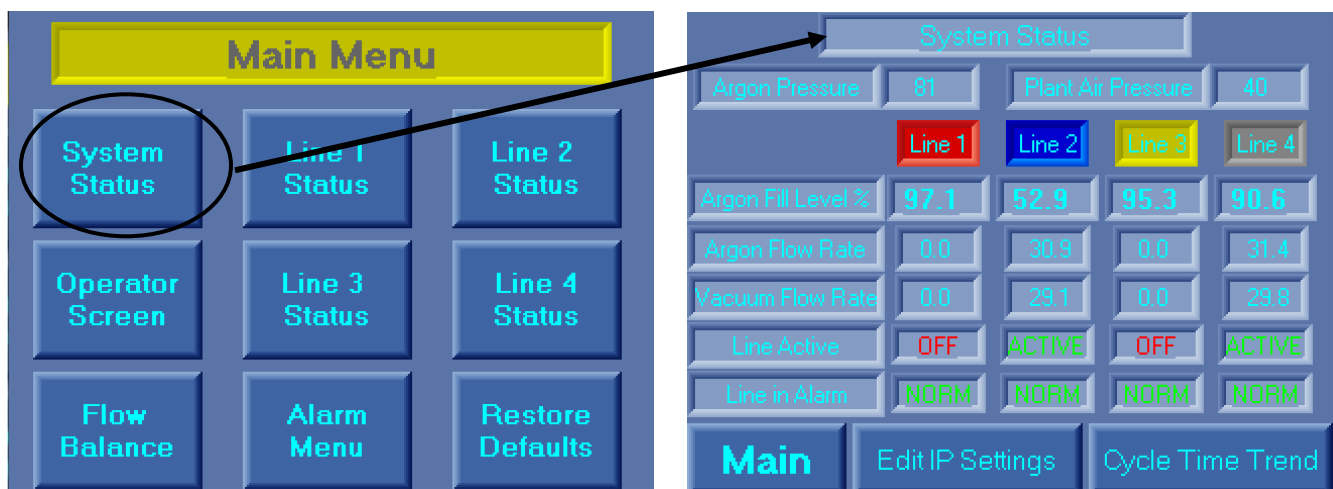


OPERATING OPTIONS

Once the AFS machine has been set up, balanced and calibrated, the system is ready for operation. There are three screens that allow the operator to view the system as it operates. If the operator only wishes to view one line and wants to view all the operating parameters of that line in a tabular format, the choice is to press the 'Line 1(2,3,or 4) Status' button on the main menu.

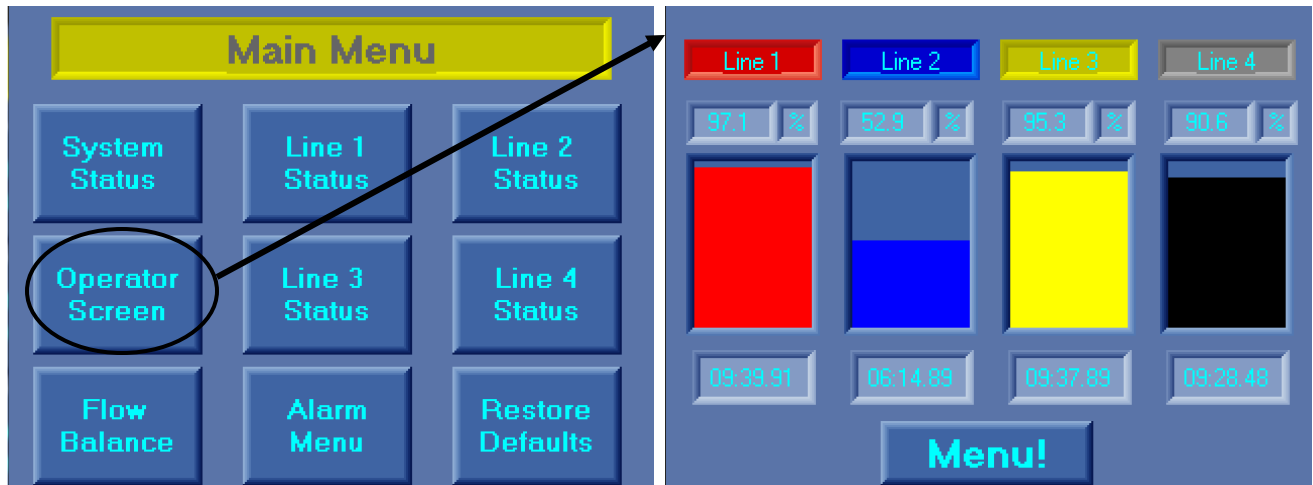


This display numerically indicates the system argon pressure (PSI), system vacuum pressure (PSI), individual argon level (%), the individual argon flow rate (l/min), the current cycle time, the individual vacuum flow rate (l/min), the line active status and the line alarm status. If the operator wishes to view this information for all four lines at once, the choice is to press the 'System Status' button on the main menu.



If the operator wishes to view the argon fill level graphically via a dynamic bar graph, along with the cycle time for all four lines at one time the choice is to press the 'Operator Screen' button on the 'Main Menu'.

NORMAL OPERATION ----- THE 'OPERATOR SCREEN'.



Filling an IGU with Argon:

1. Place the filling probe into the IGU
2. Press the green start button on the front of the panel for the line being used to fill the window
 - a. Green button will remain illuminated while filling IGU.
3. Once the process starts the argon percentage will begin to rise on the PLC screen
4. The argon will continue to rise until the argon % reaches the preselected stop level and the selected stop delay time has expired
 - a. The red button will begin to flash, indicating the cycle is complete
 - b. The PLC screen displays the maximum argon level reached by the gas sensor
5. The red flashing button can then be pressed – resetting the PLC display for the corresponding line (This step is not required – the next cycle will begin with the pressing of the green button)
6. Insert filling probe into the next IGU and repeat from step 1.

Any number of lines in any combination may be used at one time.

If for any reason the 'Argon Auto Stop' is Disabled (See Gas Sensor Setpoints), the argon filling process will continue until the operator pushes the stop pushbutton for that line.

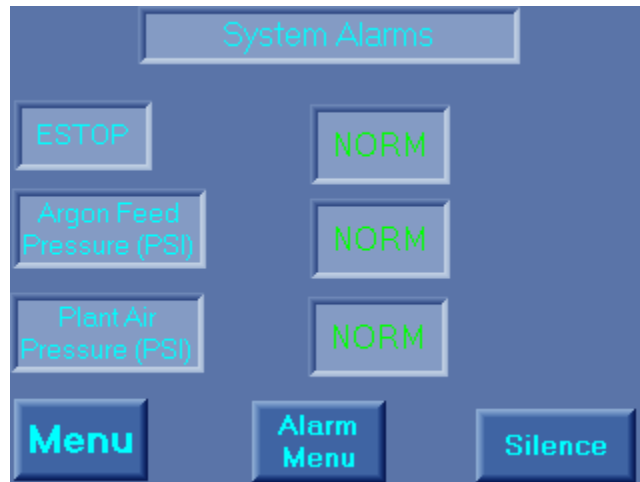
Any line may be stopped at any time by pushing the red button for that line. The process will be paused, until the green button is pressed again. This will stop only the corresponding line.

E-STOP: The emergency stop (E-Stop) pushbutton is a push-pull type. When the E-Stop pushbutton is pushed, all filling cycles are ceased. *The E-Stop button must be pulled back out before and filling can again be initiated.*

System Alarms

Should any system alarm occur, the alarm horn on the front of the panel will sound and the operator screen will automatically advance to a screen which will indicate to the operator which alarm was initiated. When an alarm screen is displayed due to an alarm occurrence, a silence button located on the bottom of the screen allows the operator to silence the audible horn. Possible alarm conditions are:

- Emergency Stop (E-Stop)
- Argon Feed Low Pressure
- Plant Air Low Pressure
- Line 1 (Red) Gas Sensor Alarm
- Line 2 (Blue) Gas Sensor Alarm
- Line 3 (Yellow) Gas Sensor Alarm
- Line 4 (Black) Gas Sensor Alarm
- Line 1 (Red) Flow Differential between the argon flow to the window and the vacuum flow from the window has exceeded an operator selectable setpoint
- Line 2 (Blue) Flow Differential
- Line 3 (Yellow) Flow Differential
- Line 4 (Black) Flow Differential



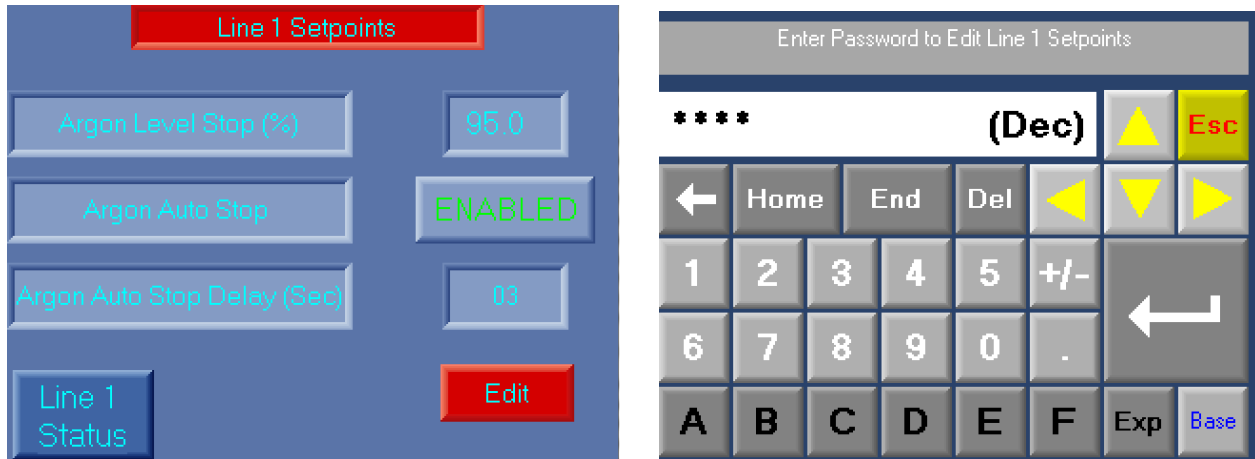
For each of the above alarms an operator selectable alarm delay time and setpoint (except E-Stop) is made available. An enable/disable function is also available for each alarm. These delay times, setpoints and enable/disables can be viewed and adjusted by pressing the 'Alarm Menu' button on the lower right hand corner of the main menu. At this time an 'Alarm Menu' will appear which allow for these adjustments.

Gas sensor alarm

An alarm setting may be configured to notify the user when an errant gas sensor calibration is made or when the gas sensor is to be replaced. A minimum difference between the 'Xducer counts' a 0% argon condition (top) versus a 100% argon condition (Bot) can be set. *A suggested minimum setting for this alarm is 100 counts.* The status of this alarm is on the O2 sensor alarm screen.

SECURITY CODING

Security coding features protect changes to key system parameters:



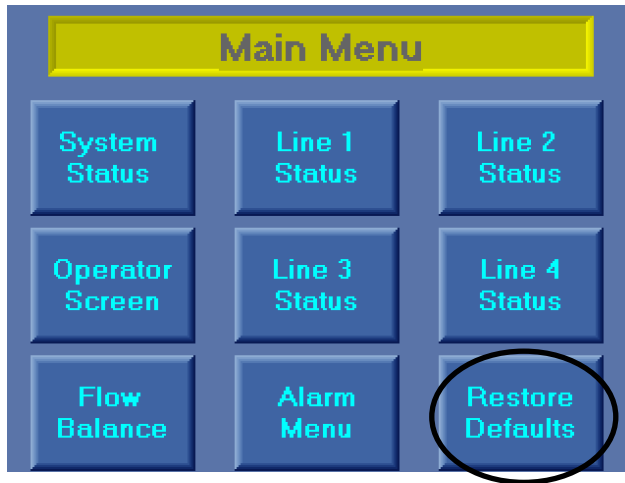
Once Edit is pressed, the operator is prompted to enter a password in order to continue to the next screen. If the operator does not know the password, the HMI will revert to the previous screen and the parameters will not be allowed to change. **All passwords for security coded screens are set to "1234"**:



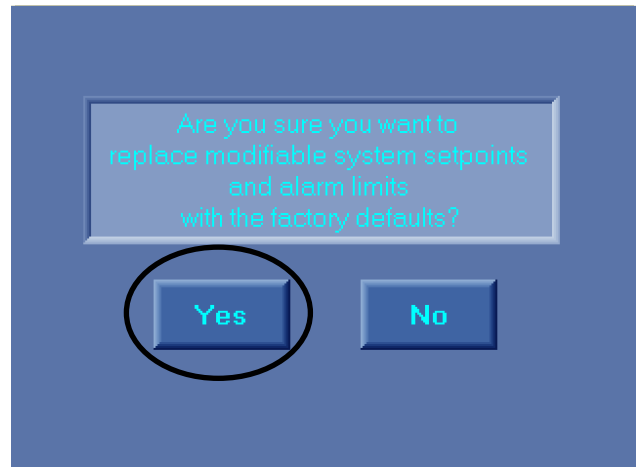
If the correct password is entered, the HMI will display a new screen that will allow the operator to change parameters or enable/disable alarms.

RESTORE DEFAULTS

One security coded option is the “Restore Defaults” option. The “Restore Defaults” button gives the operator the option to return the settings of the PLC to those which were tested at the “factory”. The following screen shots give the sequence of events for Restore Defaults:

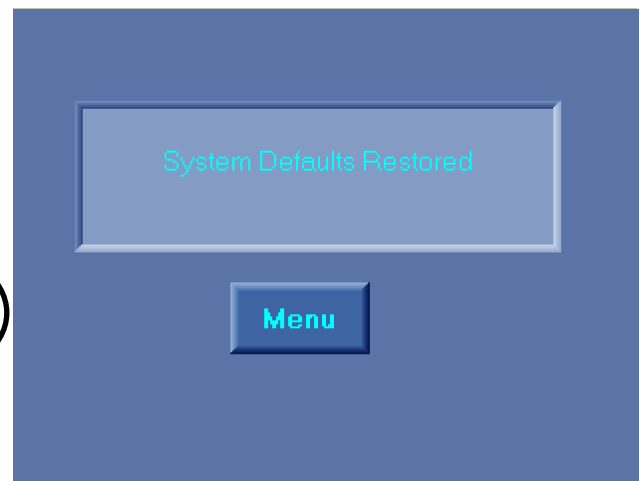
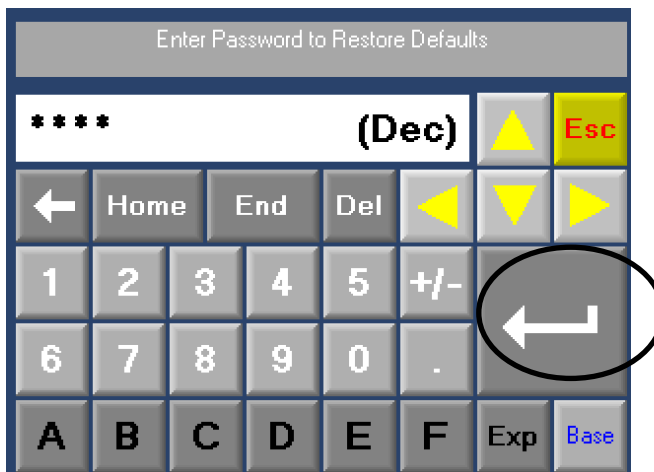


Select Restore Defaults



Select Yes:

Enter the correct password (page 12) and select Return ↵.



Factory Default parameters and their set values:

Parameter	Value Delay (Sec)			
	Line 1	Line 2	Line 3	Line 4
ESTOP			0	
Argon Feed Pressure	35		5	
Plant Air Pressure	65		5	
Replacement Top-Bot	100	100	100	100
Alarm Delay (Sec)	5	5	5	5
Flow differential	6	6	6	6
Alarm Delay (Sec)	3	3	3	3
Argon Level Stop (%)	95	95	95	95
Argon Auto Stop Delay	3	3	3	3

(AFS-4 is pictured)

Troubleshooting

Issue	Solution
<p>Line will not flow balance or remain balanced</p> <p>Note: <i>The AFS Test Vessel (Bucket) is a good verification tool to use after doing a flow balance. While holding the vessel and the probe fully inserted into the lid of the test vessel, start the filling process. Any excessive expansion or contraction of the vessel indicates the line is not balanced. A slight positive pressure is desired.</i></p>	<p>Plant air supply:</p> <ul style="list-style-type: none"> • Ensure tubing is properly connected • Ensure adequate pressure and tubing size for required flow-rate <p>Argon supply:</p> <ul style="list-style-type: none"> • Ensure tubing is properly connected • Ensure adequate pressure and tubing size for required flow-rate <p>Tubing to IG:</p> <ul style="list-style-type: none"> • Check to ensure probe(s) are properly attached and not clogged • Ensure filter is clean, cover properly installed and not broken • Check all fittings to ensure tight fit • Ensure probe is not in any IG or test chamber during flow balancing <p>Inside panel:</p> <ul style="list-style-type: none"> • Ensure regulators are set at proper pressure • Check for debris in any components: venturis, flow meters, flow needle valves, etc. Remove tubing and clean as needed • Check all fittings to ensure tight fit • Ensure jam nuts are tightened on regulators and needle valves
<p>Line starts but argon filling process does not complete</p>	<p>Ensure Argon Auto Stop is Enabled (see page 6) and fill % is properly set</p> <p>Check vacuum line probe, filter and tubing to ensure no leaks</p> <p>Ensure gas sensor is properly installed and body of sensor is not cracked</p>
<p>Breaking Glass</p>	<p>Ensure Flow balance is completed properly</p> <p>Ensure no plugs in vacuum or argon lines and probes</p> <p>Ensure all alarms are properly set and enabled (<i>note the flow differential alarm</i>)</p>
<p>Line does not start</p>	<p>Check flow differential alarm setting – make sure value is > 0 lpm</p> <p>Ensure solenoid valve wires are connected</p> <p>Ensure solenoid valves are opening (<i>push button on side of vale to manually cycle</i>)</p>

Recommended Maintenance Schedule

Maintenance Procedure	Frequency
Check lines and probes for plugs/cracks/breaks	On-going / daily
Flow Balance	Weekly EVERY PROBE CHANGE
Gas Sensor Calibration	Monthly
Clean vacuum line filters	Monthly/As required
Test Flow Balance Alarms <ul style="list-style-type: none"> • Manually plug argon line while operating • Manually plug vacuum line while operating <ul style="list-style-type: none"> ○ Ensure alarm stops line 	Monthly

System Requirements

	AFS-1	AFS-2	AFS-4	AFS-1HS	AFS-2HS	AFS-4HS
Power	110-250 VAC 50-60 HZ					
Plant Air Pressure	100 PSI – minimum ½” supply line recommended to ensure adequate flowrate					
Argon Supply Pressure	80 PSI – ensure line and manifold are capable of minimum flowrate					
	50 lpm 110 scfm	100 lpm 215 scfm	200 lpm 425 scfm	100 lpm 215 scfm	200 lpm 425 scfm	400 lpm 850 scfm



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